REMARKS

This is in response to the Office Action dated September 2, 2003. Claims 1-3 and 11-16 are pending.

General

Admitted Prior Art Figs. 5-6, which suffer from significant problems, are briefly discussed for background purposes. The prior art shown in Fig. 5 is directed to a semiconductor laser apparatus in which a laser chip 50 is bonded to a submout 51 using a metal soldering material 52. Unfortunately, because the metal soldering material 52 used to adhere chip 50 to submount 51 has a very high melting point and is too thin -- reflection problems occur (e.g., see from pg. 2, line 15 to pg. 3, line 3 of the instant specification). This reflection problem is further compounded because the soldering material 52 in Fig. 5 is so thin that it does *not* extend up the end surface(s) of the chip – thereby allowing a highly reflective end surface(s) of the chip to remain uncovered.

In contrast to the prior art of Fig. 5, the prior art of Fig. 6 does not use metal soldering material, but instead uses conductive die-bonding paste 56 to bond laser chip 50 to sub-mount 51. However, the semiconductor laser apparatus of Fig. 6 is problematic in that swelling of paste 56 causes the adhesive to extend up the opposing end surfaces of chip 50 thereby *covering up* the light emitting/receiving points thereof (see pages 4-5 of the instant specification).

The instant inventors have discovered a way in which to control the swelling of conductive die-bonding paste used for bonding a laser chip to a sub-mount or the like. In

particular, the instant inventors have found that by pre-heating the sub-mount to a particular temperature(s), swelling of the conductive die-bonding paste can be controlled so as to allow the paste to move up the end surface of the chip but stop short of the light-emitting/receiving point(s) (e.g., see pgs. 11-14 of the instant specification). In certain embodiments, the conductive paste may comprise an epoxy resin and at least 80% by weight conductive filler particles such as silver.

Fig. 3 illustrates an example embodiment of this invention. In Fig. 3, a laser apparatus is illustrated which includes semiconductor laser chip 5 whose bottom is die-bonded to a bonding surface 1a of stem (or sub-mount) 1 with a conductive die-bonding paste 20. The semiconductor laser chip 5 has a light-emitting/receiving point 6, 7 at each of opposed end surfaces thereof. Because of the aforesaid pre-heating of the stem 1, it is possible to control swelling of the conductive die-bonding paste 20 so that the paste 20 adheres to a lower part of each end surface of the chip 5 (covering portions of the respective end surfaces of the chip that may be highly reflective) but stops short of the light-emitting/receiving point(s) 6, 7. In other words, in certain embodiments the highest position of the conductive die-bonding paste 20 on the lower part of each end surface of the semiconductor laser chip 5 is at a height of more than 0.01 mm from the bonding surface and hence from the bottom of the semiconductor laser chip, but is below the light-emitting point 6 and/or 7 of the chip. This is advantageous in that (a) the light-emitting/receiving point(s) of the laser chip are not covered up by the conductive paste thereby improving laser operation, and (b) regular reflection of an auxiliary beam does

not occur due to the partial covering of the end surface(s) thereby leading to less noise generation (e.g., see pages 16-17 of the instant application).

An example technique for making a semiconductor laser apparatus according to certain embodiments of this invention is described on pages 11-14 of the instant specification. In summary, the stem 1 is preheated at about 60-80° C which is lower than the temperature at which the conductive die-bonding paste 2 starts a thermosetting reaction. The conductive die-bonding paste 2 is high in viscosity and swells in the shape of a drop of water on a surface immediately after it has been applied to the stem 1, as shown in Fig. 2A. The preheating reduces the viscosity of the conductive die-bonding paste 2, thereby reducing swelling so that paste 2 diffuses to form a preheated thin paste as shown in Fig. 2B. Accordingly, the preheating at a temperature in the range of 60 - 80°C reduces the viscosity of the conductive die-bonding paste so as to reduce swelling thereof, without causing hardening of the paste (e.g., see pg. 12 of the instant specification). After the semiconductor laser chip 5 is mounted on the preheated conductive die-bonding paste 20, the paste is heated to a heightened temperature in order to start the thermosetting reaction, whereby the conductive die-bonding paste 20 is fully hardened or set. As a result of this technique, swelling of the paste is controlled so that the paste swells upward across part of the end surface(s) of the laser chip but that swelling is *limited* so that it does not swell or rise above a main-discharge-side light-emitting point 6 or a monitoring-side light-emitting point 7 of the semiconductor laser chip 5 (each light-emitting point may be at a height of about 0.05 mm).

In certain embodiments of this invention, the laser apparatus may be used in an optical pick-up using a three beam scheme (e.g., see pgs. 13-14 of the instant specification). In such embodiments, of the three beams, the main beam returns to the light-emitting point, whereas one auxiliary beam travels above the semiconductor laser chip 5 and the other auxiliary beam is scattered by the conductive die-bonding paste 20 but is not regularly reflected on the discharge surface of the semiconductor laser chip 5. As a result, the auxiliary beams do not return to an optical detector thereby reducing generation of noise.

Section 112 Rejection

Claims 1, 13 and 14 stand rejected under 35 U.S.C. Section 112, second paragraph. The Office Action contends that "there is no structure recited to obtain a semiconductor laser apparatus." This Section 112 rejection is respectfully traversed for at least the following reasons.

Claim 1, for example, clear recites "a semiconductor laser apparatus comprising a semiconductor laser chip whose bottom is die-bonded to a bonding surface . . . . said semiconductor laser chip having a light-emitting point at each of opposed end surfaces thereof." Clearly, this recited structure calls for a semiconductor laser apparatus. The Office Action's contention that "there is no structure recited to obtain a semiconductor laser apparatus" is clearly wrong.

The other claims also recite a semiconductor laser apparatus including a laser chip with a light emitting point(s). Again, the Office Action's contention that "there is no structure recited to obtain a semiconductor laser apparatus" is clearly wrong.

The Section 112 rejection should be withdrawn.

Claim 1 – Art Rejection Under § 103(a)

Claim 1 stands rejected under 35 U.S.C. Section 103(a) as being allegedly unpatentable over JP 11-284098 in view of Honda (US 6,210,811). This Section 103(a) rejection is respectfully traversed for at least the following **four (4) reasons**.

Claim 1 requires that "a highest position of the conductive die-bonding paste on said lower part of each end surface of the semiconductor laser chip is at a height of more than 0.01 mm from the bonding surface and from the bottom of the semiconductor laser chip, but is below the light-emitting point of the semiconductor laser chip of the semiconductor laser apparatus. The cited art fails to disclose or suggest this aspect of claim 1, either alone or in combination.

First, the Examiner's interpretation of JP 11-284098 on which the rejection is based is wrong. The Examiner has misinterpreted JP 11-284098. In particular, the "vertical length" referred to in the English abstract of JP 11-284098 means a direction *parallel* to the surface of the submount – not perpendicular to the surface of the submount as apparently alleged in the Office Action. The "vertical length" referred to in JP 11-284098 is entirely unrelated to the invention of claim 1 because this is merely referring to the direction parallel to the support surface. The very basis of the Section 103(a)

rejection is thus in error, meaning that the Section 103(a) rejection is incorrect and should be withdrawn.

Second, JP 11-284098 has been misinterpreted by the Examiner in another respect. Fig. 6 of JP 11-284098 is prior art, and is expressly criticized by JP 11-284098. In particular, JP 11-284098 criticizes Fig. 6 thereof as being problematic in that the metal filler 3 covers up much of the end of the laser chip thereby interrupting the laser beam. JP 11-284098 solves the problem of prior art Fig. 6 by locating the metal filler 3 (brazing) only within the periphery of the chip as shown in Figs. 1-4, at least 10 μm from the periphery of the chip. The 10 μm value along the length of the submount surface discussed in JP 11-284098 relates to Figs. 1-4 – not to prior art Fig. 6 as apparently alleged in the Office Action. Importantly, the invention of JP '098 lies in Figs. 1-4 where the *brazing material 3 does not touch either end surface of the laser chip* (directly in contrast with claim 1 of the instant application). Thus, any combination of Honda with Figs. 1-4 of JP '098 still would not meet the invention of claim 1 since the material 3 would not contact either end surface of the laser chip.

Third, any combination of Honda with prior art Fig. 6 of JP '098 would also not meet the invention of claim 1 since the emission point of the chip would be covered. Additionally, the metal brazing material 3 in Fig. 6 of JP '098 is not conductive paste comprising resin as required by claim 1. Accordingly, it can be seen than any alleged combination of JP '098 and Honda still would not meet the invention of claim 1.

Fourth, if one of ordinary skill in the art would have used Honda's epoxy in JP '098, this would have been used as taught by JP '098 entirely within the periphery of the chip as shown in Figs. 1-4 (JP '098 expressly states that the Fig. 6 design therein is undesirable and should not be used). Again, this would not meet the invention of claim 1 since the material 3 would not contact an end surface of the chip. However, even if one were to use Honda in combination with Fig. 6 of JP '098, the result would be the problematic covering of the light emission points as discussed in JP '098 and as shown in Fig. 6 of the instant application; again, this would not meet the invention of claim 1 since the material 3 would cover the emission point of the chip.

For at least the four (4) reasons set forth above, the Section 103(a) rejection of claim 1 is incorrect and should be withdrawn.

Other Claims

Claim 13 requires that "a highest position at which the conductive die-bonding paste adheres to at least one end surface of the semiconductor laser chip is at a height of more than 0.01 mm from the bonding surface, but is below the light-emitting point of the semiconductor laser chip . . . . wherein the conductive die-bonding paste comprises epoxy resin and at least 80% by weight conductive filler of metal particles or flakes." The cited art fails to disclose or suggest these aspects of claim 13.

Claim 14 requires that "the conductive die-bonding paste adheres to a lower part of each end surface of the chip from the bottom up to a height below the light emitting point so that when the apparatus is used in the optical pickup an auxiliary beam directed

from an optical disk to the lower part of one of the end surfaces is scattered by the conductive die-bonding paste adhering thereto." Again, the cited art fails to disclose or suggest this aspect of claim 14.

Conclusion

For at least the foregoing reasons, it is respectfully requested that all rejections be withdrawn. All claims are in condition for allowance. If any minor matter remains to be resolved, the Examiner is invited to telephone the undersigned with regard to the same.

Respectfully submitted,

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